Computation of Vernalis Salinity in CALSIM II

Review and Recommendations

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Computation of Vernalis Salinity in CALSIM II

Presentation Outline

- Background information
- Description of the current mass balance
- Validation tests
- Recommendations

Computation of Vernalis Salinity in CALSIM II

Background

- Water Quality at Vernalis is defined in 1995 WQCP
- EC at Venalis
  - 1000 μmho/cm, Non-Irrigation (Sep – Mar)
  - 700 μmho/cm, Irrigation (Apr – Aug)
- Met through New Melones releases
  - New Melones water is limited
  - Alternative methods to meet Vernalis EC

Computation of Vernalis Salinity in CALSIM II

Background

- Accurate method for computing Vernalis EC in the planning model is essential
- Projects that would benefit
  - Revised IOP for New Melones
  - Enlarged Friant Study
  - Salinity TMDLs on lower SJR
  - San Luis Drainage Project

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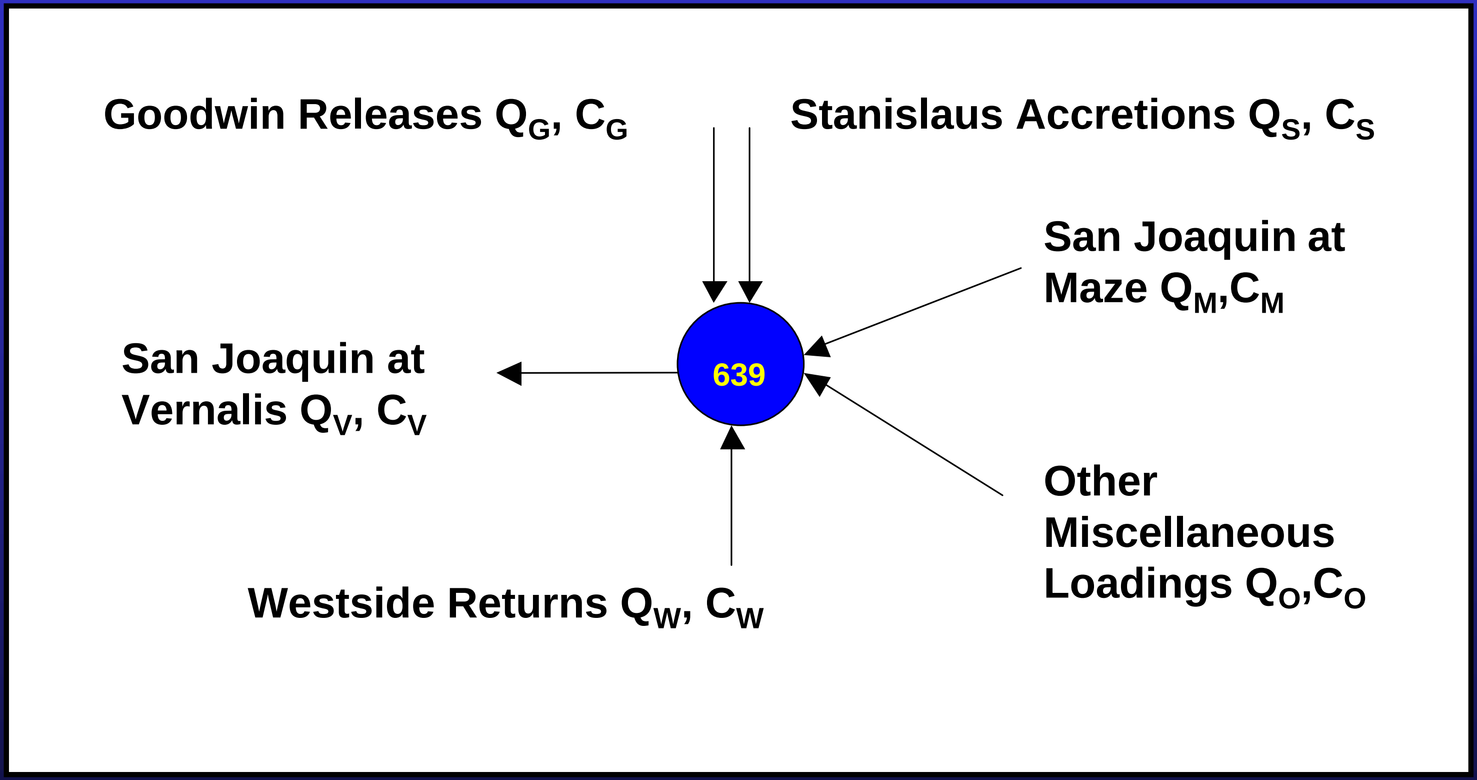
Description of the Mass Balance



$$C_V = \frac{\left(Q_M C_M + Q_G C_G + Q_S C_S + Q_W C_W + Q_O C_O\right)}{Q_V}$$

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Stanislaus Flows

- Goodwin Releases Q_G
- Stanislaus Accretions Q_S

$$Q_S = C530A + R523 + I524 - D524 - D525 + C531$$

- Oakdale ID Return Flows
- Modesto ID Return Flows
- Stanislaus River Accretions
- Stanislaus River Depletions
- Stanislaus River Riparian Diversions
- Combined Returns of SSJID and Riparian Diversions

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Westside Return Flows

$$Q_W = R639 + R629 + R623C + R615 + C619 + I611$$

- Includes
  - Westside Irrigation Districts
  - Combined Mud and Salt Slough

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Calsim Default EC Values

Salinity Component	Non-Irr. EC Oct-Feb (μmho/cm)	Irr. EC Mar-Sep (μmho/cm)
Goodwin Release	85	85
Stanislaus Accretions	380	190
Westside Returns	2,300	2,300

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The Maze Component

- Considered as the weakness of the Vernalis EC mass balance
- Uses the Modified Kratzer Equation to compute Maze EC
- Westside return flows are broken out of the Maze flows

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History of the Modified Kratzer Equation

- Original Kratzer developed by the SWRCB in 1990
- Computes Maze EC from Maze flow volume
- Used Maze Flow and EC data from 1986-1989
- Modified in 1995 by USBR
- Subtracted out Westside Returns and redeveloped the curve fit

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Assumptions for Modified Kratzer

- Westside Flows
  - Lesser of 20,000 AF
  - or 35% of monthly Maze flow (Oct-Feb, Non-Irr)
  - or 60% of monthly Maze flow (Mar-Sep, Irr)
- Westside Salinity
  - 1,700 ppm, (~2,600 μmho/cm,Oct-Feb)
  - 1,500 ppm (~2,300 μmho/cm, Mar-Sep)

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Maze EC, The Modified Kratzer Equation

$$C_M = K_1 * V_M^{-K_2}$$

Where

C_M = Maze EC (µmho/cm)

V_M = Maze Flow Volume (acre-feet)

K_1 = 866,201.49 (Non-Irrigation Season)

= 54,645 (Irrigation Season)

K_2 = -0.69289 (Non-Irrigation Season)

= -0.44346 (Irrigation Season)

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Validation Tests

- Validations tests were conducted to determine the performance of the Vernalis mass balance
- Compared computed EC against observed EC
- Two tests were performed

1) Comparison of CALSIM II generated EC versus observed EC (scatter plots)

2) Application of historic flow data to Vernalis mass balance (time series plots)

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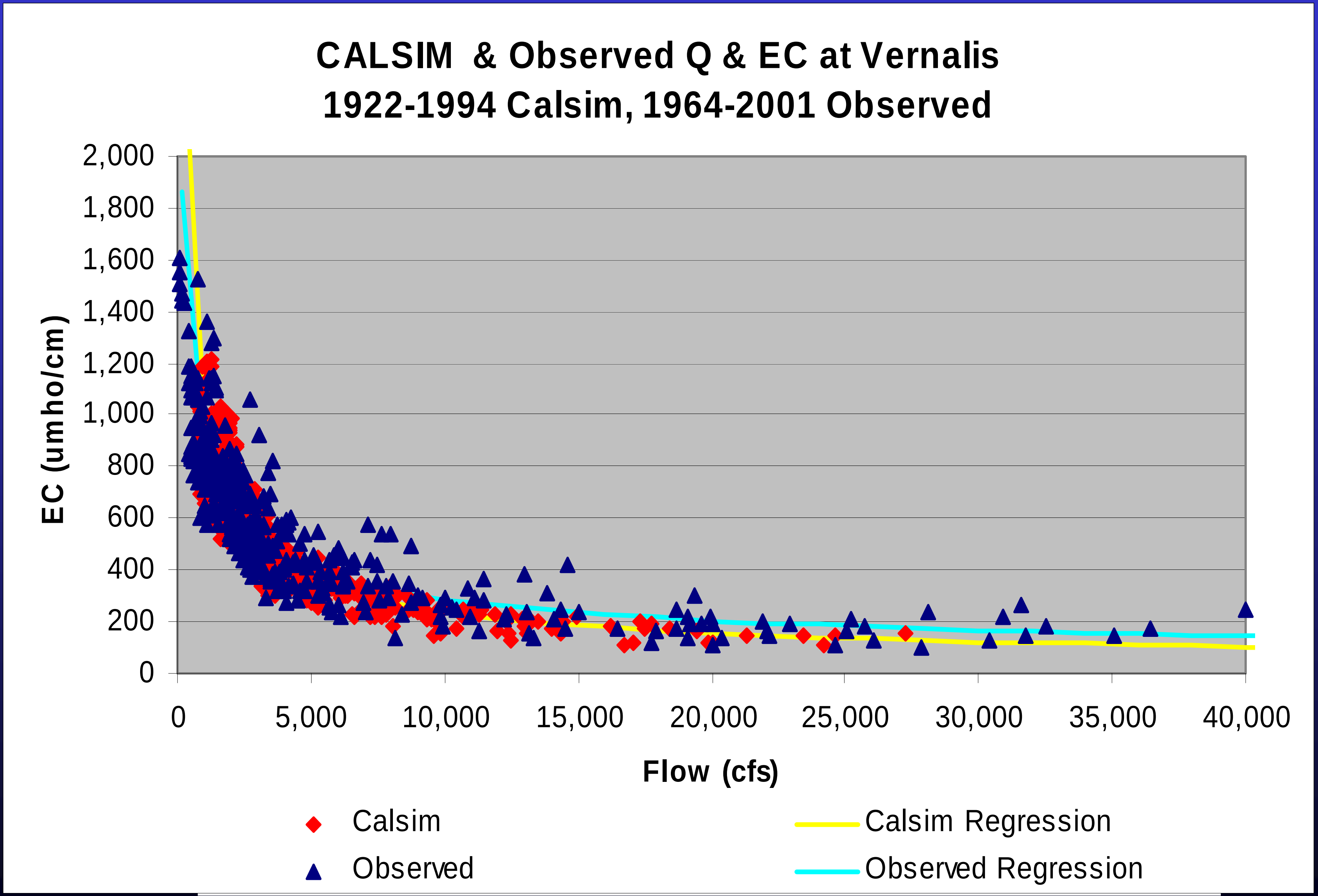
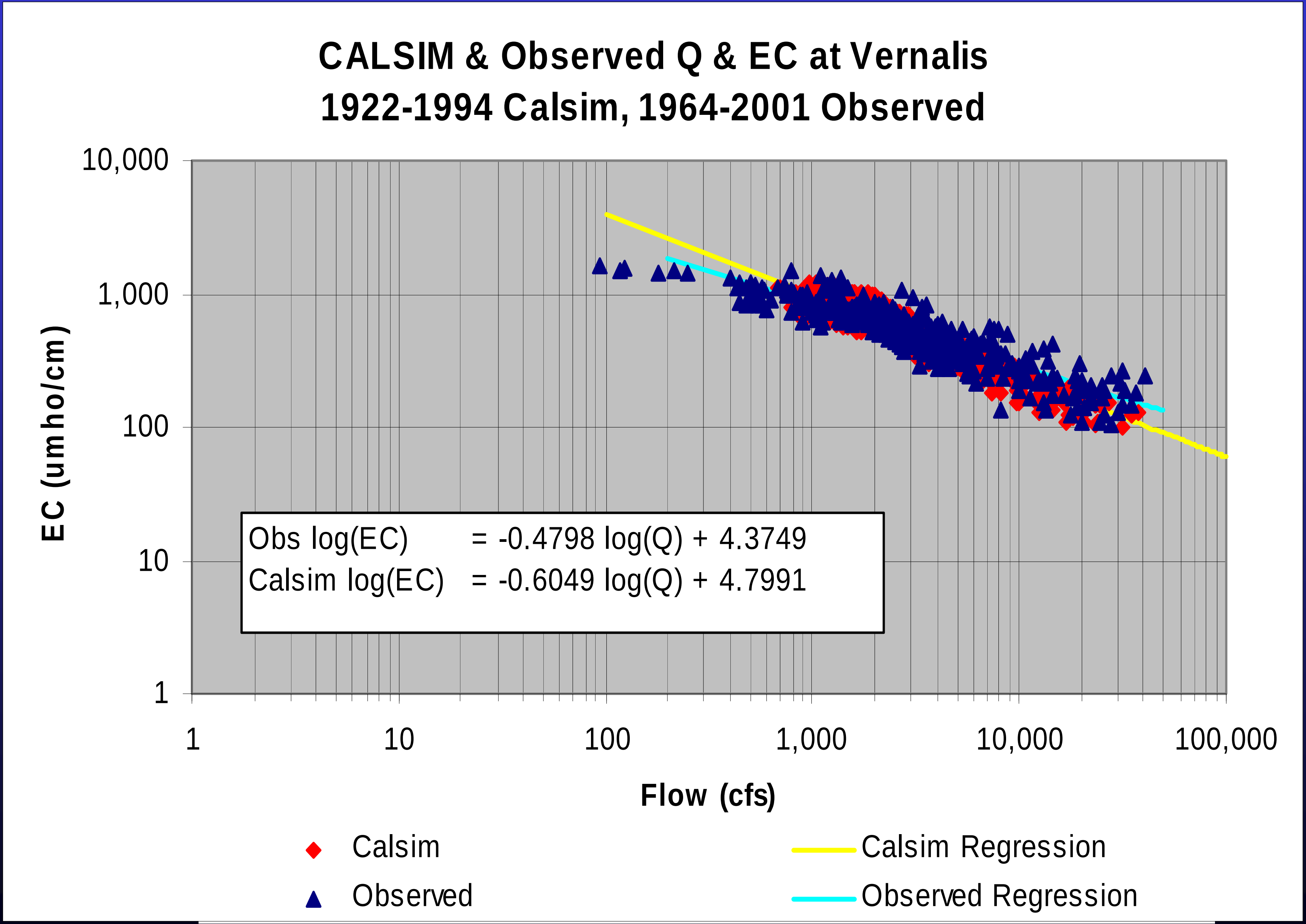
Validation Test 1

- Calsim II generated EC compared against observed EC
- Sep 30, 2002 Benchmark used
- Direct comparison of time series plots cannot be made.
- Scatter plots of Vernalis EC vs. flow can be compared
- For a good match, scatter points and best fit curves should overlay each other

Validation Test 1



Validation Test 1



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Findings of Validation Test 1

- For the most part, the scatter points of Calsim EC and observed EC matched fairly well.
- Calsim II tends to overestimate EC for low flows and underestimates for high flows.
- The crossover point from overestimating to underestimating is about 3000-4000 cfs

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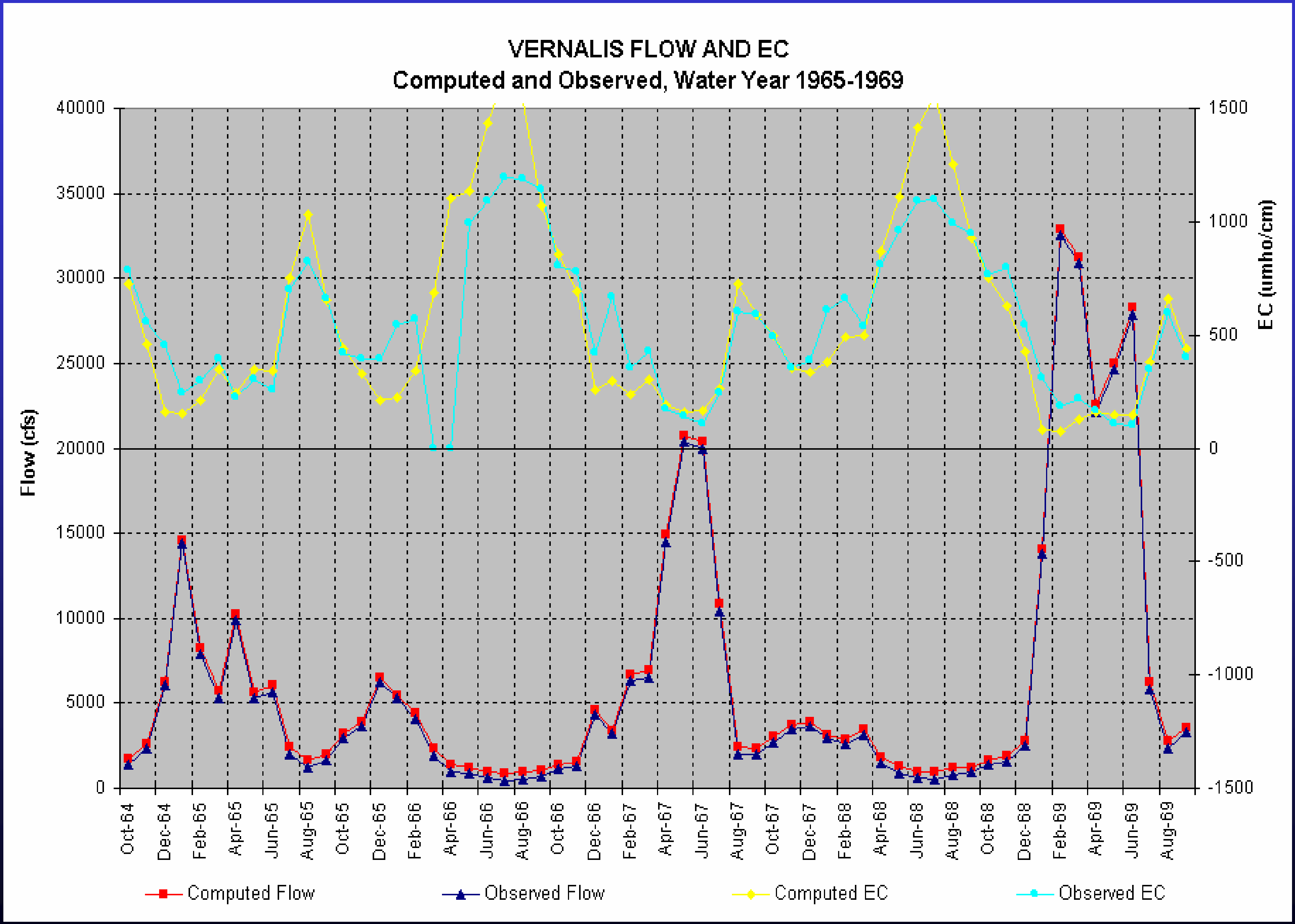
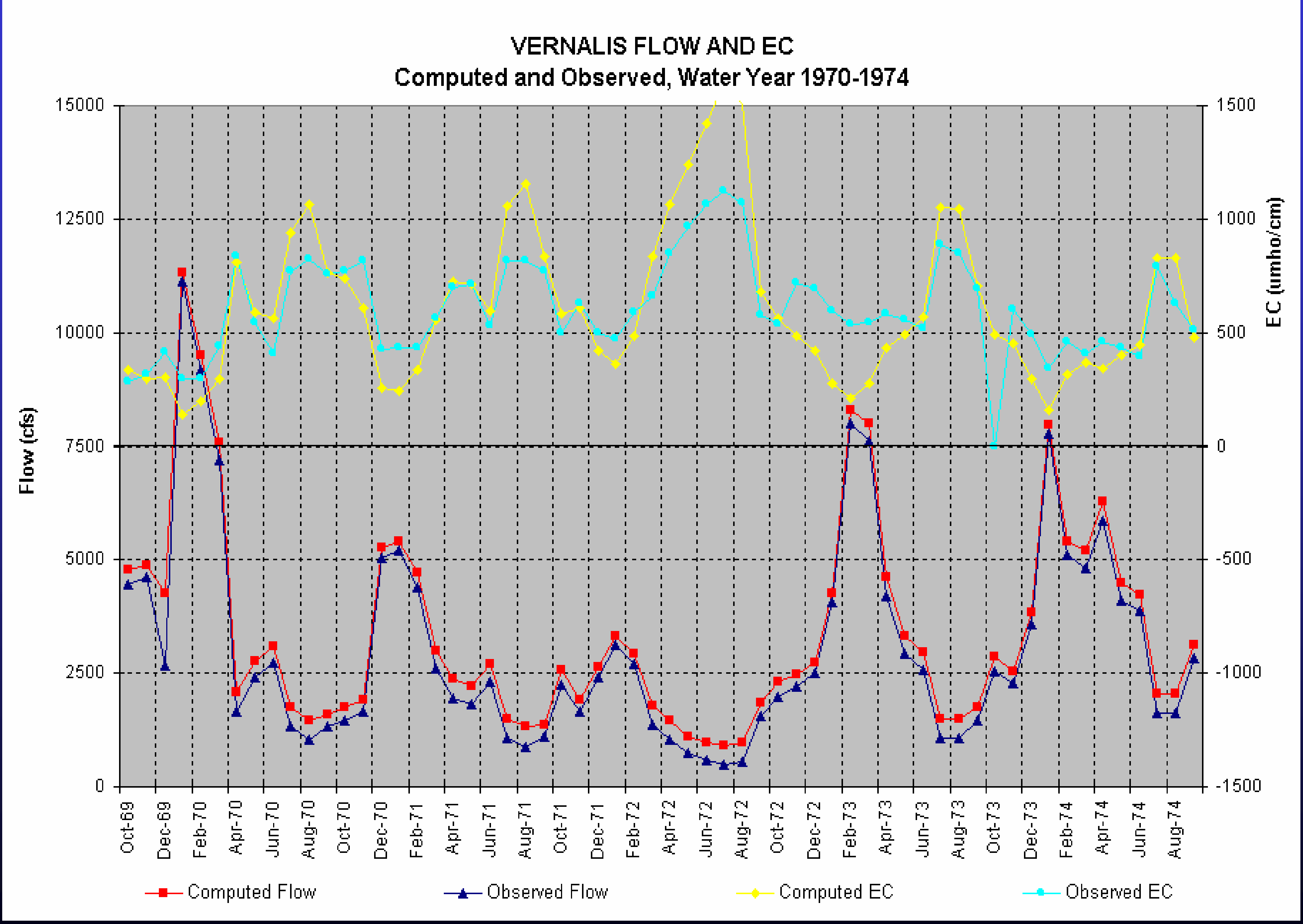
Validation Test 2

- What are the months that the mass balance overestimates and underestimates
- Need time series plots
- Applied historic flow data from 1965-1998 to the Vernalis mass balance
- Compared time series of computed salinity to observed salinity

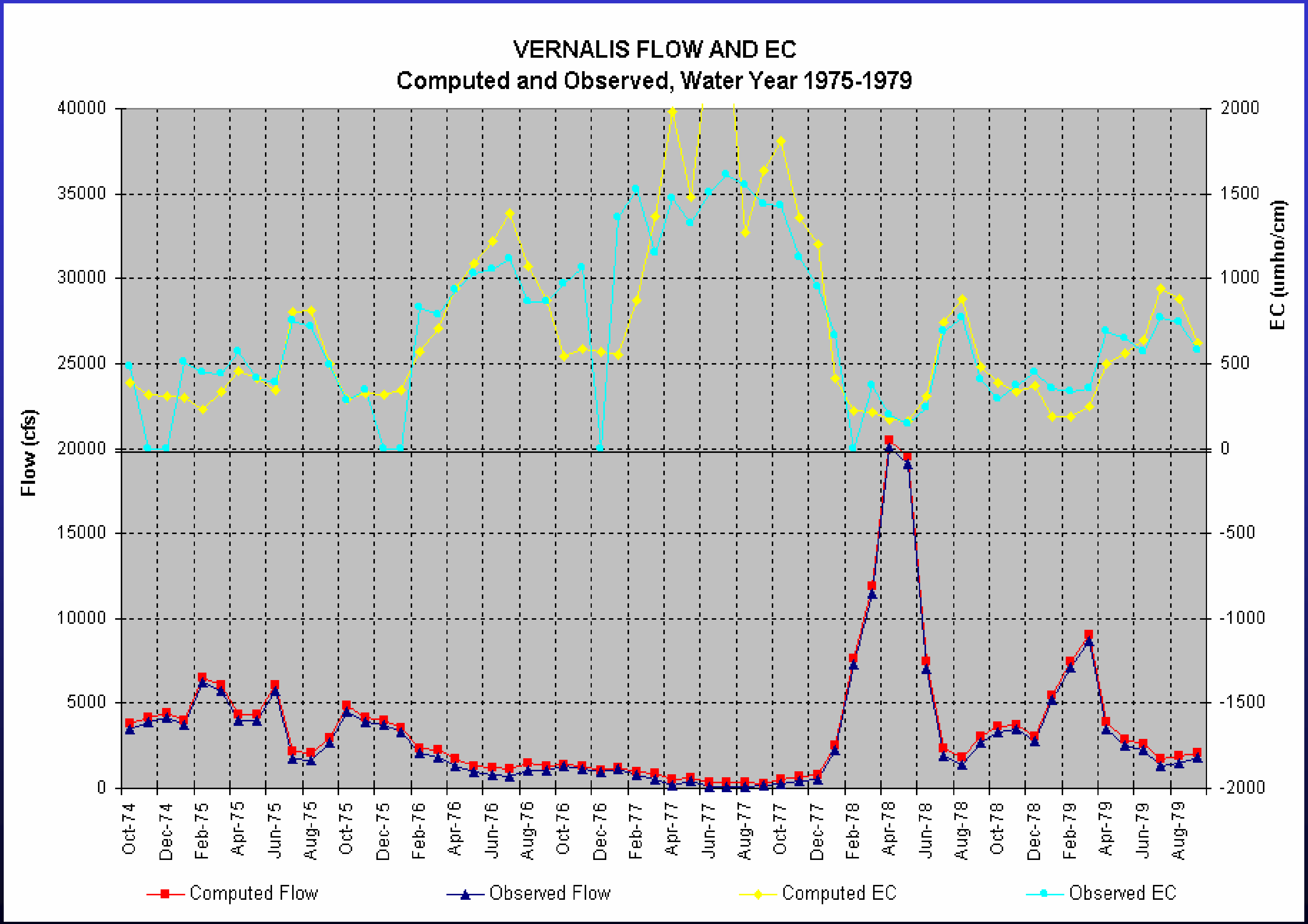
Validation Test 2, 1965-1969



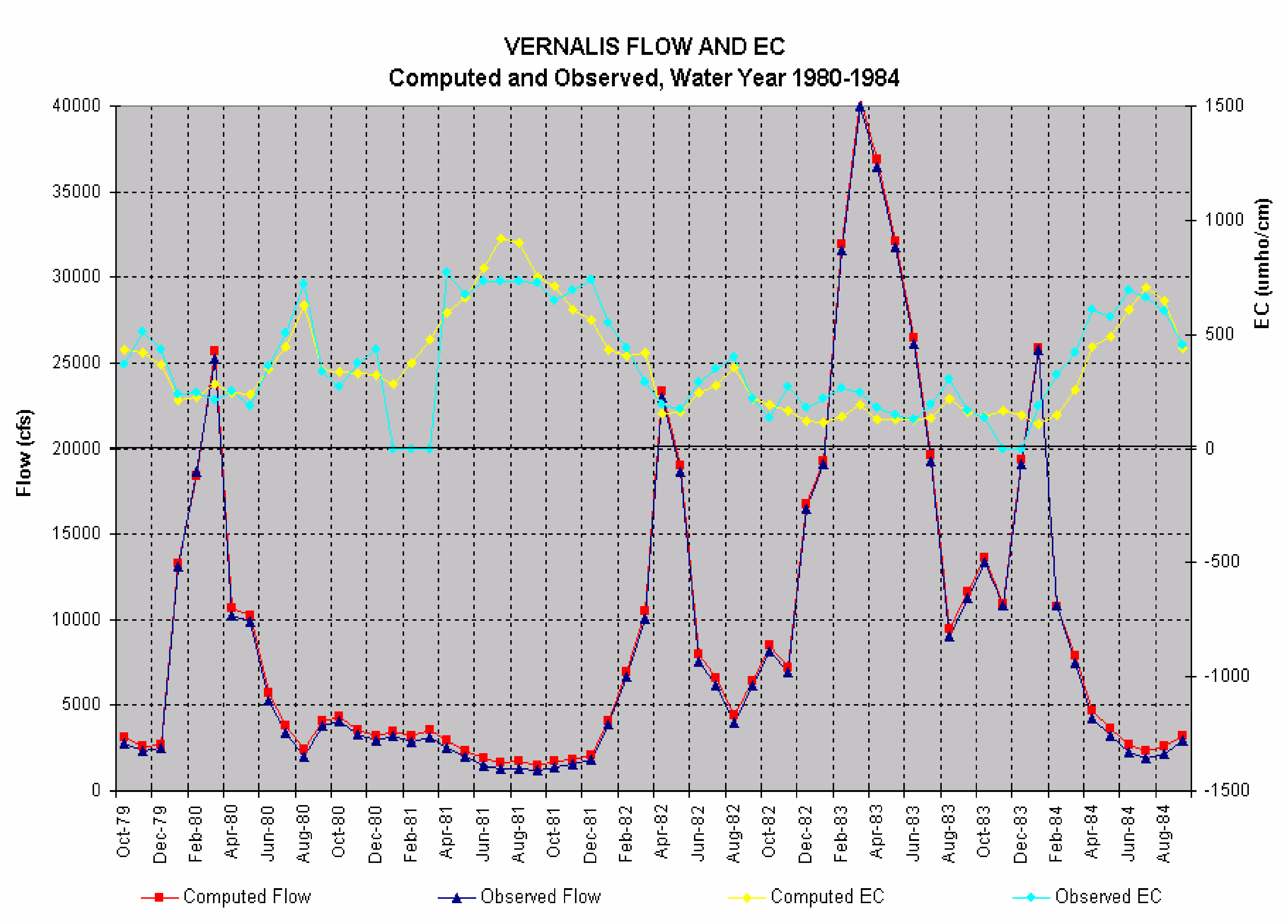
Validation Test 2, 1970-1974



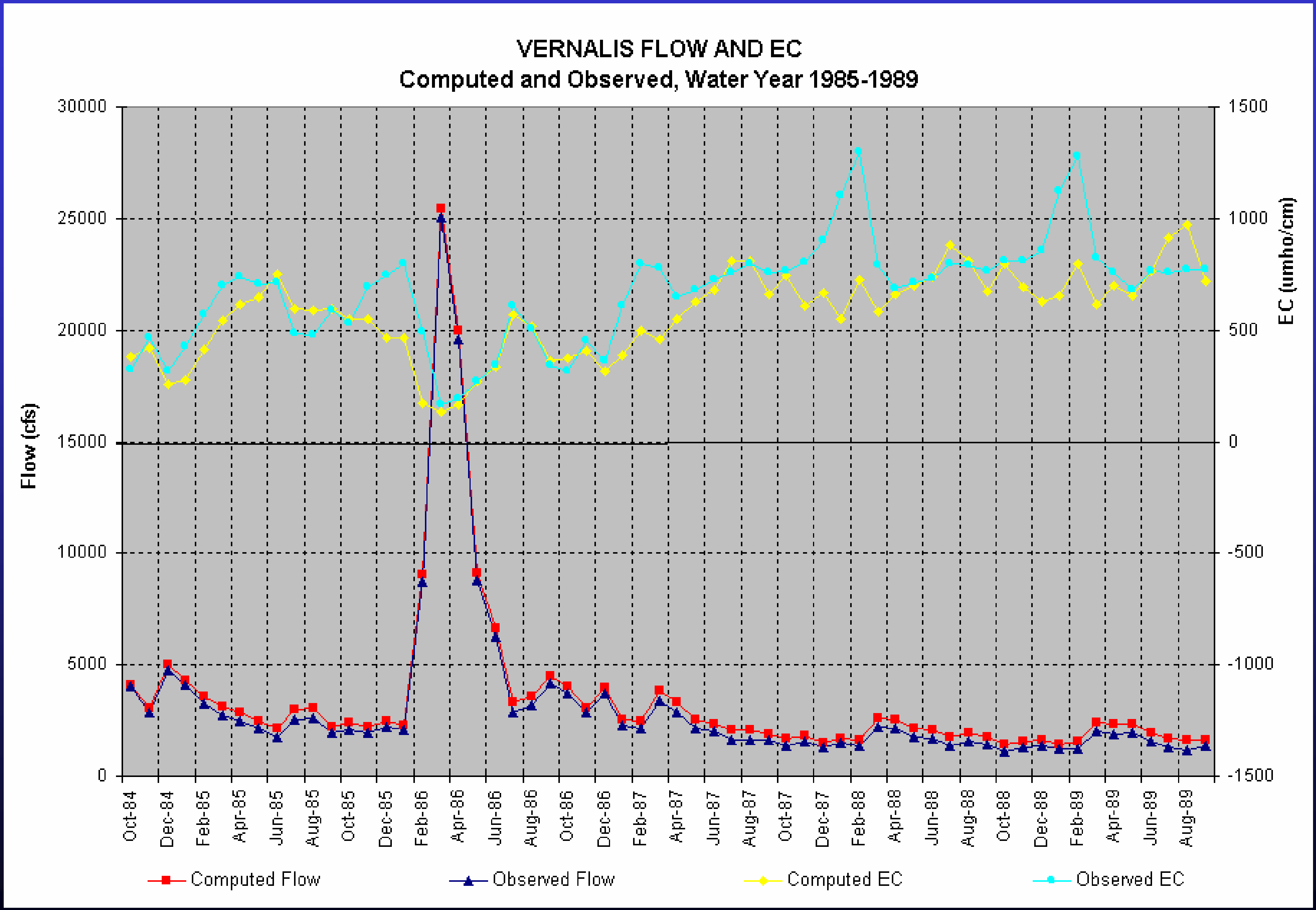
Validation Test 2, 1975-1979



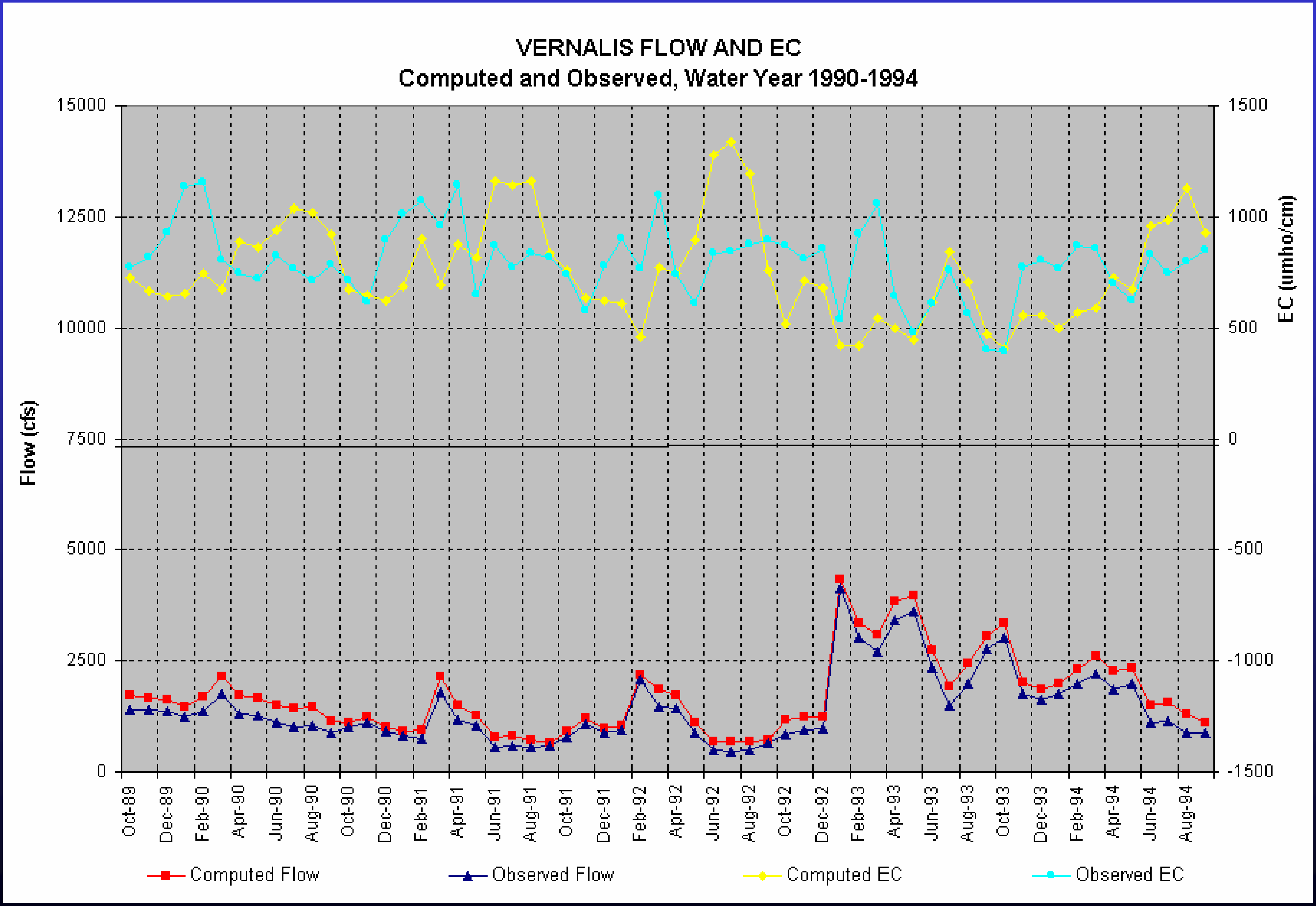
Validation Test 2, 1980-1984



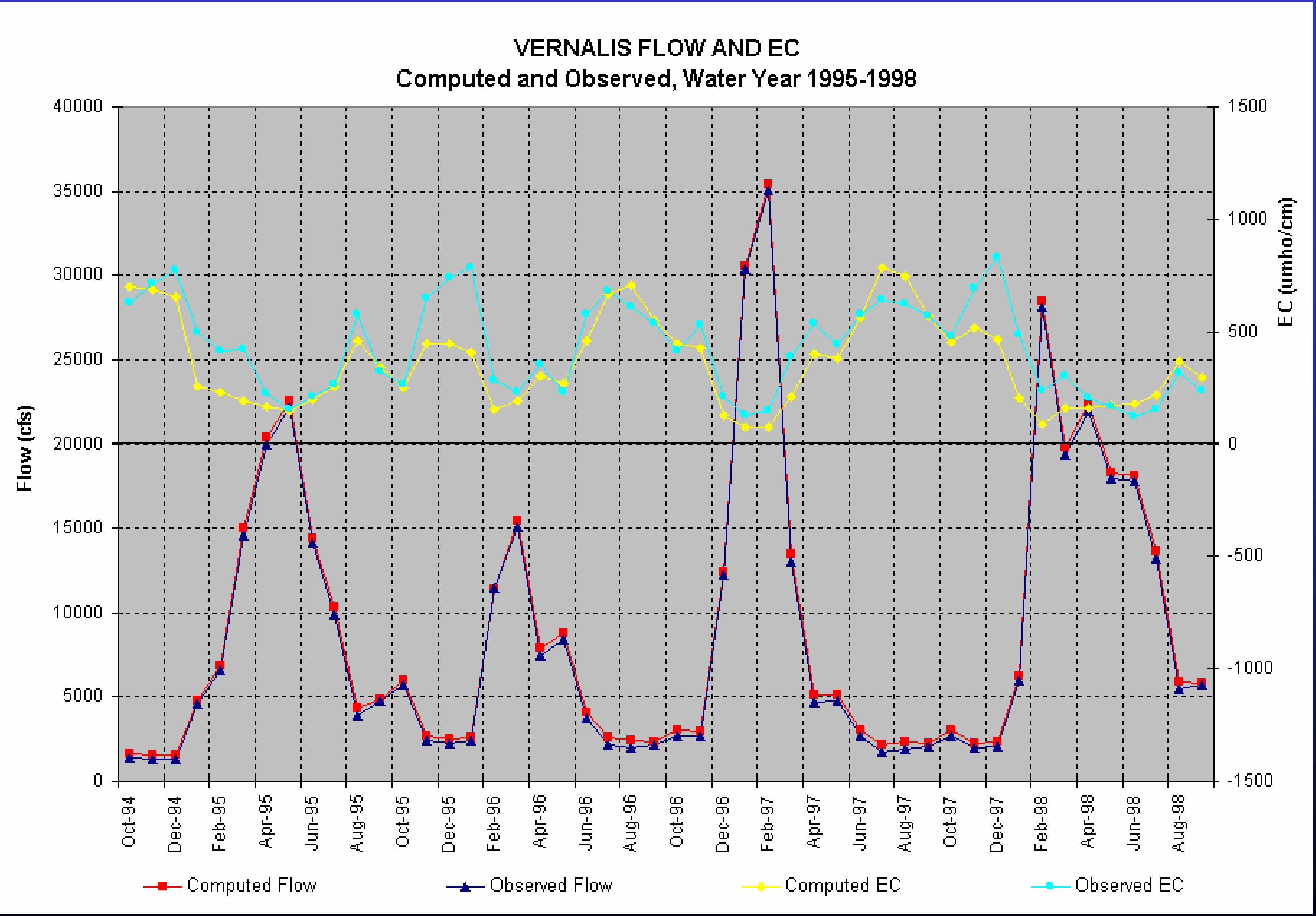
Validation Test 2, 1985-1989



Validation Test 2, 1990-1994



Validation Test 2, 1995-1998



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Findings of Validation Test 2

- The Vernalis mass balance overestimates during the summer and underestimates during the winter
- The mass balance performs better for the period 1965-1984 than for 1985-1998
- Over and under estimations could be caused
  - Modified Kratzer Equation
  - A lack of detailed modeling of Westside return flows
  - Inappropriate values for Eastside and Westside return flow EC

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Recommendations

- Abandon the Modified Kratzer Equation
- Adopt a link-node approach in 3 Phases
- Phase 1, Extend the mass balance further upstream
  - Start the first mass balance at Lander Ave.
  - Use established regressions for Lander Ave, Merced River and Tuolumne River
  - Code into CALSIM

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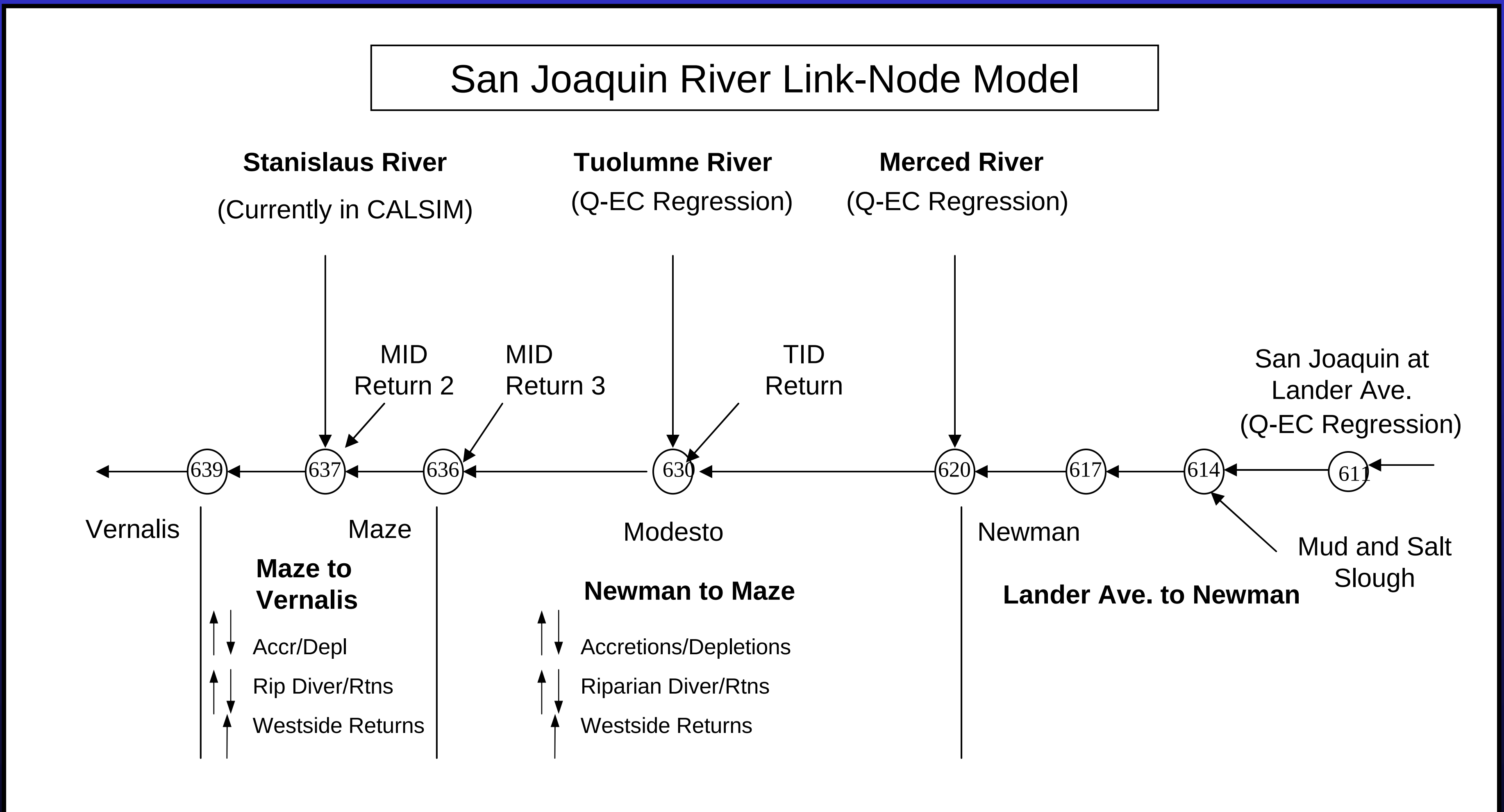
Schematic of the Link-Node Method



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Recommendations (cont.)

- Phase 2, Model the Westside in more detail

  - Model Mud and Salt Slough separately (base flow, ag return flows and wetland release flows)
  - Model the Westside accretions (base groundwater, creek flows)
  - Model the Westside Ag Drainage (surface water returns, pumped groundwater returns, tile drainage)
  - Research EC values from RWQCB reports
  - Code into CALSIM

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Recommendations (cont.)

- Phase 3, Collect additional Westside & Eastside drainage data
  - Update existing flow-EC relationships with new data to ensure robustness
  - Establish regionally based EC values for the Westside and Eastside Irrigation Districts
  - Update the EC values in CALSIM II (also in DSM2-SJR)

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Benefits of the Link-Node Approach

- Preliminary testing show this may eliminate some of the overestimation problem

- Will be a more defendable approach

- Will be more computationally consistent with existing water quality models for the San Joaquin River

  - SJRIO

  - DSM2-SJR